Final Draft Child Use Area
Arsenic and Lead Soil Sampling Guidance

1.0 Background Information

This *Child Use Area Soil Sampling Guidance* is one of a series of guidance documents developed by the Washington State Department of Ecology (Ecology) to help homeowners, businesses, developers, and local governments characterize arsenic and lead concentrations in soil for the purposes of reducing exposure to these common soil contaminants.

1.1 Where do elevated levels of arsenic and lead in soil typically occur?

Ecology has identified soil in large areas of Washington State that have low to moderate levels of contaminants, principally arsenic and lead. The primary causes of this widespread or area-wide contamination are metal smelters, lead arsenate pesticide applications, and leaded gas emissions from automobiles. These historical practices released arsenic and or lead to the environment over hundreds of square miles in both eastern and western Washington through airborne particulate (smelters) and or direct application (pesticides). Leaded automobile gas (used from 1923 to the mid-1970s) emissions released lead to the environment, particularly in high-traffic urban corridors. The consequence of these historical practices is that arsenic and lead concentrations in shallow soil may be elevated above natural background levels and exceed Ecology soil cleanup levels.

A potentially common source of localized lead in soil near older houses (pre-1978) is lead-based paint. Flaking and chipping of old lead-based paint due to weathering and maintenance activities can result in elevated lead concentrations surrounding the perimeter of a building. A potentially common source of localized arsenic in soil is outdoor wood structures built with arsenic preservative-treated wood (arsenic-treated wood is being phased out of use beginning in 2002). Lead-based paint and arsenic-treated wood impacts to soil are usually localized directly adjacent to a building or play structure where these products were used.

1.2 Purpose of this guidance.

This *Child Use Area Soil Sampling Guidance* has been prepared for businesses and local governments who are interested in identifying ways to reduce soil arsenic and lead exposure to children who play at child use areas on their property or facility. This guidance explains how property owners or managers can collect and analyze soil samples from their child use area properties.

Soil sampling is presented as a three-step process. The first step is planning the sampling – deciding where and how to collect soil samples at your property. The second step is actual sample collection by you. The third step is getting the sample analyzed by a private laboratory.

The resulting laboratory data can be used by business owners, school districts, and other local government officials to help manage potential exposure to soil arsenic and lead. This guidance is not intended to meet sampling requirements for State hazardous waste cleanups or real estate transactions.

State hazardous waste cleanups are administered by Ecology under the Model Toxic Control Act (MTCA), a state law that provides for investigation and cleanup of contaminated properties. MTCA is a formal program with specific procedures for addressing soil contamination. Compliance with MTCA may require additional sampling beyond recommendations in this guidance. Ecology Toxic Cleanup Program staff can provide additional information on MTCA requirements to interested individuals. Ecology maintains offices in different regions of the State. Appropriate Ecology contact phone numbers by region are presented on the attached map at the back of this guidance.

Organizations or individuals involved in real estate transactions (lenders, buyers, and real estate agents) may request soil sampling, especially in areas of the state where area-wide contamination has been associated with historical smelter operation or pesticide use. In these situations, the involved individuals typically define the sampling requirements. Contact involved individuals for more information on sampling requirements for your real estate transaction.

1.3 What is a Child Use Area?

For the purpose of this guidance, a child use area (CUA) is defined as an area where children play regularly, apart from their homes. CUAs may include schoolyards; parks; child care facilities and preschools; camps; some property developments (e.g., apartments with common areas); and vacant lots. CUAs have specific intensive use areas where children congregate. Examples of intensive use areas are: picnic areas, ball fields, sand boxes, swings, climbing structures, horse riding and grooming areas, and commons areas.

For the purposes of this guidance, children are defined as age 17 and younger. Young children are defined as age 6 and younger.

1.4 Why should I be concerned about arsenic and lead in soil?

Arsenic and lead occur naturally in soil. However, exposure to elevated soil concentrations can affect a person's health. For low to moderate lead and arsenic concentrations chronic or long-term effects are the primary health concern. Chronic exposure to arsenic and lead may lead to a variety of symptoms. Chronic arsenic exposure is known to cause cancer; chronic lead exposure is known to have toxic effect on the human nervous system. Young children are at greatest risk for a variety of reasons, including the likelihood of increased exposure through normal hand-to-mouth activity and increased susceptibility to development impairment of the central nervous system.

More information on the toxicity of arsenic and lead can be found at the following web sites published by the Agency for Toxic Substances and Disease Registry (ATSDR):

Arsenic: http://www.atsdr.cdc.gov/tfacts2.html

Lead: http://www.atsdr.cdc.gov/tfacts13.html.

Various government agencies have been evaluating the extent of arsenic and lead soil impacts associated with the former Tacoma Smelter in Ruston, Washington. Three good general sources of information on soil arsenic and lead impacts are Ecology, the Seattle-King County Health Department, and the Tacoma-Pierce County Health Department:

Ecology: http://www.ecy.wa.gov/programs/tcp/sites/tacoma_smelter/ts_fs.htm

Ecology: http://www.ecy.wa.gov/programs/tcp/area_wide/area_wide_hp.html

King County: http://www.metrokc.gov/health/tsp/arsenic.htm

Pierce County: http://www.healthdept.co.pierce.wa.us/eh/arsenic.htm.

The State Department of Health (WDOH) is another source of information on lead in soil. The WDOH fact sheet discusses health effects and ways to minimize exposure specifically as it pertains to children. The WDOH web site is:

WDOH Fact Sheet: http://www.doh.wa.gov/Topics/Childhood%20lead%20Poisoning.htm.

1.5 How will soil sampling help me?

There are a number of relatively simple actions that you can take to prevent exposure to arsenic and lead in soil. What actions you take may depend on the amount and location of arsenic and lead in soil on your property. Past studies have shown that the amount of arsenic and lead can be quite variable – that is, even samples taken close together can have very different results. This may be especially true in CUAs where past facility construction or landscaping may have involved soil excavation or movement. Because soil testing results can be so variable, you cannot reliably predict soil

concentrations in or around a CUA based on larger studies or even results from a nearby CUA. Sampling is the only reliable way to tell what soil concentrations are on your property. Once you know the location(s) of any elevated arsenic and lead soil at your CUA, you can take steps to reduce contact with that soil by children.

2.0 STEP 1: Planning the Sampling

2.1 Where do I collect the samples?

If your property is affected by area-wide arsenic and/or lead contamination, the concentrations of arsenic and lead in soil on your property will vary from one location to the next. The cause of the variability is due to a number of factors including the source of the contamination (i.e., smelter, pesticide use, or automobile emission); topography; climate; and past land use practices that cause soil disturbance or mixing. Consequently, sampling in one area will not necessarily provide reliable information on another area. To characterize your property, you will need to collect samples from each intensive use area on your property where children play. An efficient way to do this is to divide your property into subareas prior to collecting samples. The purpose of defining subareas is to group soil samples together from areas of your property with similar characteristics. Each area on the property designed for child play, socializing, or activity will be a separate "intensive use" subarea.

Since the main concern is child exposure to contaminated soil, you should define intensive use areas based on exposure potential. The three most important criteria for defining child exposure potential are:

- Where is exposed dirt?
- Where do children usually play?
- Where do children spend the most time?

Portions of the property that are not defined as an intensive use subarea may be grouped together and designated as the peripheral subarea. The entire peripheral subarea is typically designated as one or two subareas depending on the size of the property and its characteristics. A good rule of thumb is to limit peripheral subareas to about 2 acres (equivalent to an area of about 430 ft by 200 ft) or less in size. An example of a school/park property segregated into intensive use and peripheral subareas for soil sampling is shown on Figure 1.

Each property will have different characteristics and will be used in different ways for different purposes. It is up to the property owner or manager to make informed decisions about how to delineate subareas. The maximum size of a subarea where young children (i.e., 6 years old and younger) typically play should typically not be larger than about a tenth of an acre (equivalent to an area of about 40 ft by 100 ft). The maximum size of subareas designed for older children may be larger (e.g., soccer or ball fields).

Surfacing characteristics of certain types of intensive use areas may limit exposure to contaminated soil. Examples include ball courts with hard impermeable surfaces or play areas with at least 12 inches of gravel or wood chips. In these instances it is probably not necessary to sample the underlying soil because the exposure potential for children is limited.

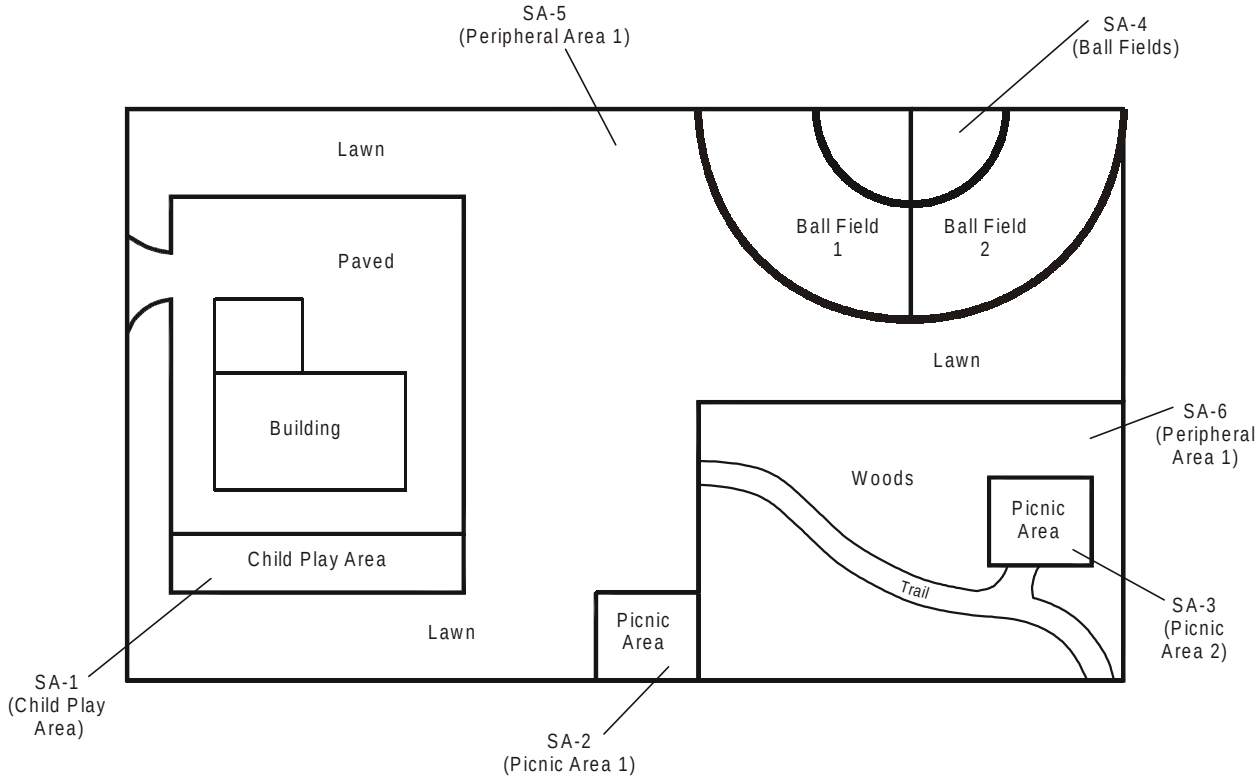


Figure 1 Example Subareas Within Child Use Areas on a Property

2.2 How many samples should I collect?

The average soil concentration over a subarea is the most important characteristic for evaluating potential long-term exposure. Because there can be wide variations in arsenic and lead soil concentrations, it is necessary to collect more than one sample from a subarea to get a reliable

estimate of the average soil concentration. In general, more samples collected at different locations within a subarea will provide a better estimate of the average. Ecology recommends collecting a minimum of four samples per subarea, regardless of size. If young children use an intensive use area, then a minimum of eight samples is recommended for the corresponding subarea. In general, the larger the subarea, the more samples should be collected.

2.3 How do I decide where to collect samples within a subarea?

A minimum of four samples should be collected from each subarea. Sample locations should be selected to represent good geographic coverage within each subarea. A simple way to achieve this goal is to separate each subarea into approximately equal-sized blocks. Collect a single sample from the approximate center of each block. Keep in mind that the sample location should generally be representative of the subarea as a whole. For example, if you sample near older buildings or wood play structures, your sample results could be influenced by lead-based paint or arsenic-treated wood impacts. An example of appropriate sampling locations for different CUA property subareas is presented on Figure 2.

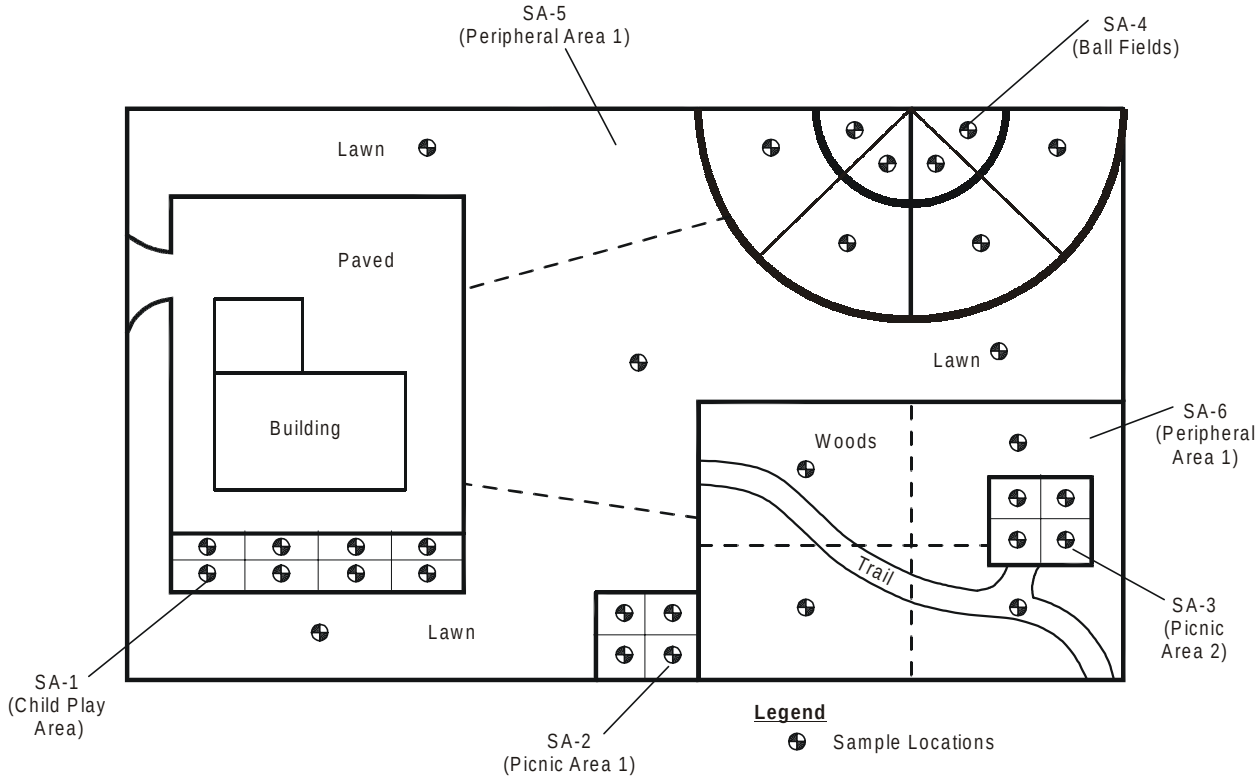


Figure 2 Example Sample Locations for a Child Use Area Property

2.4 What are composite samples?

Increasing the number of samples collected from a subarea provides a better estimate of soil concentration, but has the disadvantage of increasing laboratory analytical costs. Laboratory analytical costs can be reduced by mixing individual samples together from different locations within a subarea into a single individual sample for analysis. This is called *compositing*, and gives an "average" result for all the soil that was mixed into the sample. For example, if four samples are collected to characterize a subarea, a reasonable estimate of the average concentration can be obtained at a reduced cost by compositing (mixing) the four samples into a single sample prior to laboratory analysis. Compositing is demonstrated schematically on Figure 3.

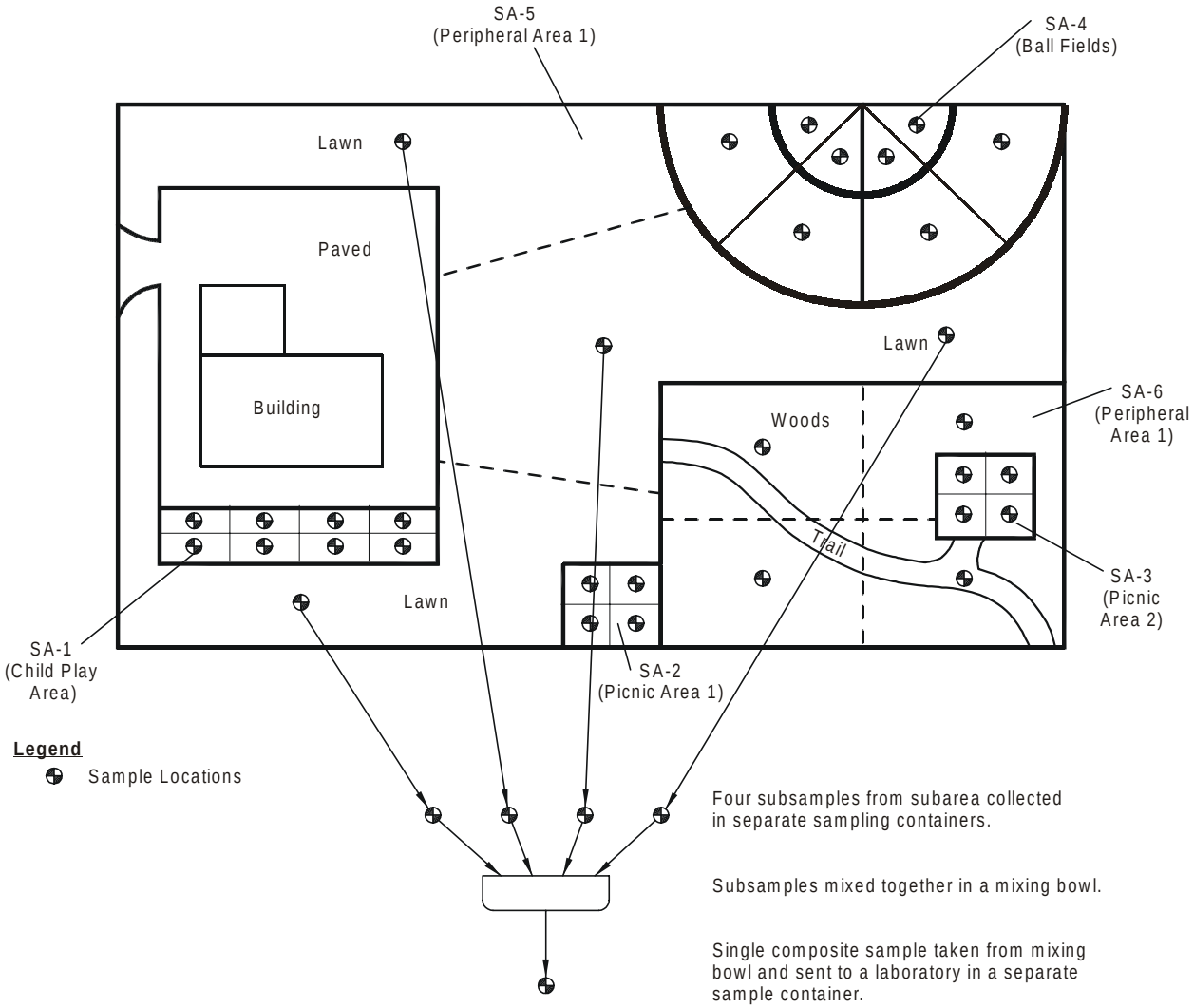


Figure 3 Example of a Composite Sample for Subarea 5: Peripheral Area 1

Compositing is not recommended for intensive use subareas where young children play. Otherwise, the decision to composite is the choice of the property owner or user. The composite sample result provides an acceptable estimate of average soil concentration for evaluating exposure. It does not provide information on the variability of the contamination or whether some parts of an area have higher concentrations than other parts. If you are interested in a more comprehensive understanding of arsenic and lead concentrations on your property, you should analyze each sample individually. Also, discrete sample results may be required if the data are to be used for MTCA compliance.

2.5 How deep should I sample?

Under most child play scenarios, exposure to soil arsenic and lead is primarily from the surface soil layer. Therefore, it is recommended that you collect your soil sample from the surface to a depth of 6 inches. Your sample should consist of soil, avoid collecting organic debris or gravel. Clear or cut away grass, gravel, wood chips, or other similar materials prior to collecting your sample.

Keep in mind that collecting and analyzing a soil sample from the upper 6 inches of the soil column will provide a good estimate of an individual's likely exposure to arsenic and lead. The test result will not necessarily provide a good estimate of deeper soil contamination, should it also exist on your property.

2.6 Do I have to sample for both arsenic and lead?

A number of studies have been completed to evaluate the characteristics of area-wide soil contamination. If the source of contamination is from historical smelter discharges or lead arsenate pesticide application, soil with elevated arsenic concentrations will also likely have elevated lead concentrations, though arsenic tends to represent the greater health concern. If the source of contamination is automobile leaded gas emissions or lead-based paint then only lead will be elevated. If the source is treated wood then only arsenic will be elevated.

It is recommended that soil samples be analyzed for both arsenic and lead to get a clearer picture of soil contamination impacts on your property, especially if young children are likely to be exposed. If costs are a concern, it may be acceptable to collect a sample just for arsenic if the suspected source is from historical airborne smelter deposition, lead arsenate pesticide application, or treated wood. In these circumstances, if arsenic concentrations are low, lead concentrations are also likely to be low.

2.7 Step 1 Summary:

- Divide your yard into subareas based on potential for exposure to soil.
- Collect a minimum of four samples from each subarea and a minimum of eight samples from any intensive use areas – more where young children are likely to be exposed.
- Do not composite samples from subareas where young children play. Otherwise, composite the samples or keep them separate, depending on cost constraints, potential future use of the data (i.e., MTCA compliance), and level of detail you want.
- Collect samples evenly throughout the subarea.
- Sample to a depth of 6 inches.
- Sample for arsenic and lead.

3.0 STEP 2: Sample Collection Methods

Once you have planned your sampling, the soil samples are relatively easy to collect. The following steps provide a cost-effective way to get good quality and representative samples:

1. Mark your sample locations with a stake or flagging tape. It may also be useful to prepare a site diagram that shows where samples were collected.
2. Assemble the necessary equipment:
    - Shovel, trowel, or bulb planter
    - Clean stainless-steel or plastic spoon
    - Permanent marking pen
    - Small ZipLoc^{tm} plastic bags or glass sampling containers (about 4 ounces in size; you can get these from the laboratory)
    - Paper towels or wash bucket and scrub brush.
    - Large stainless-steel, plastic, or glass bowl (if compositing).
3. Collect the soil sample:
    - Using the permanent marker, label a ZipLoc^{tm} bag or glass container with the following minimum information:
        - Unique sample identifier (i.e., SS1A for soil sample A from subarea 1)
        - Your name
        - Date
        - What you want to be analyzed (arsenic and lead).
    - Clear away any surface debris or grass mat layer.
    - Dig a 6-inch deep hole with your shovel, trowel, or bulb planter.

- Using the spoon, scrape fresh soil from the sides of the hole and fill up the plastic bag or the jar. Avoid or discard soil pebbles and rocks. Be sure to collect soil from throughout the entire depth interval.
- Either discard the spoon or clean it using a paper towel or wash bucket and scrub brush. If the spoon is to be used again, it should be free from any visible dirt.
- Securely seal the sample jar or ZipLoc^{tm} bag.

4. If you are compositing:
   - Collect all individual samples (as described above) from a subarea first. Then put equal amounts of soil from each sample directly into the large bowl.
   - Thoroughly mix the soil.
   - Using the spoon, fill up the plastic bag or the jar with the mixed soil.
   - Discard remaining soil.
5. Catalog all soil samples on a sheet of paper. Form 1 is included at the end of this guidance for this purpose. Indicate which samples are composites. Store the samples together in a large ZipLoc^{tm} bag, box, cooler, or similar container with a copy of the sample inventory sheet for reference.

4.0 STEP 3: Getting the Samples Analyzed

4.1 How are the samples analyzed?

The levels of arsenic and lead are determined by sending your soil samples to a laboratory that has the capability to perform metals analyses in soil. You should transport the samples to the laboratory as soon as convenient after the samples have been collected. The samples can be delivered to the laboratory or shipped using a parcel service. The samples should be stored in a cool, dark place. If you will not be able to get the samples to the laboratory for a week, it is suggested that the samples be refrigerated. Once the laboratory receives the samples, they should be able to perform the analysis and report the results to you within 3 to 4 weeks.

The laboratory can use a variety of methods to analyze for arsenic and lead. It is recommended that you request the samples be analyzed by either of two methods:

- the ICP/MS (inductively coupled plasma mass spectrometer) method, also known as U.S. Environmental Protection Agency (EPA) Method 6020A.
- the GFAA (graphite furnace atomic adsorption spectroscopy) method, also known as EPA Method 7010.

Prior to analysis, the laboratory should thoroughly mix each individual sample. The size of soil in the sample should be less than 2 millimeters (2 mm) or about a tenth of an inch. If the soil grain size appears to be greater than 2 mm, you should request the laboratory screen the samples to remove all soil and debris in the sample greater than 2 mm. This may result in an extra cost.

The laboratory should report the sample concentrations in units of milligrams per kilogram (mg/kg) or parts per million (ppm) (these two are equivalent to each other). The samples should also be reported relative to the dry weight of the soil (e.g., "on a dry weight basis"). Instruct the laboratory to screen the samples (if necessary) and report the results on a dry weight basis, using the units noted.

Finally, the samples have to be analyzed so that very low concentrations can be determined accurately. When submitting the samples to the laboratory, they should be instructed that the analytical reporting limits should be no greater than 5 ppm arsenic and 10 ppm lead.

4.2 How do I find an appropriate analytical laboratory?

Analytical laboratories are listed in the yellow pages. You do not necessarily need to use a lab near to your home, however, because many labs can work with you through the mail. Only a relatively small subset of laboratories is capable of analyzing metals in soil. When you talk to the laboratory you should ask the following questions:

- Do they have the capability to analyze arsenic and lead in soil by either of the methods listed above?
- Will they be able to screen the sample to 2 mm if necessary?
- Can you mail samples to them?
- How much will it cost?
- How long will it take?

If the answer to the first two questions is yes, the laboratory should have the capabilities of providing you with an accurate soil sample analysis. The cost of the analysis should be about $30 or $40 per sample, per analysis. There may be an additional fee if the samples need to be screened to 2 mm.

Ecology maintains a list of laboratories that are accredited by the state to perform soil analyses. This web site, http://www.ecy.wa.gov/programs/eap/labs/srchmain.htm, may be useful in helping you locate an appropriate laboratory to complete your sample analyses. For example, if you use this web site for arsenic, select "Chem II (Trace Metals)" as the general category and "Arsenic (6020)" as the parameter (method).

4.3 Step 3 Summary:

Instruct the laboratory to:

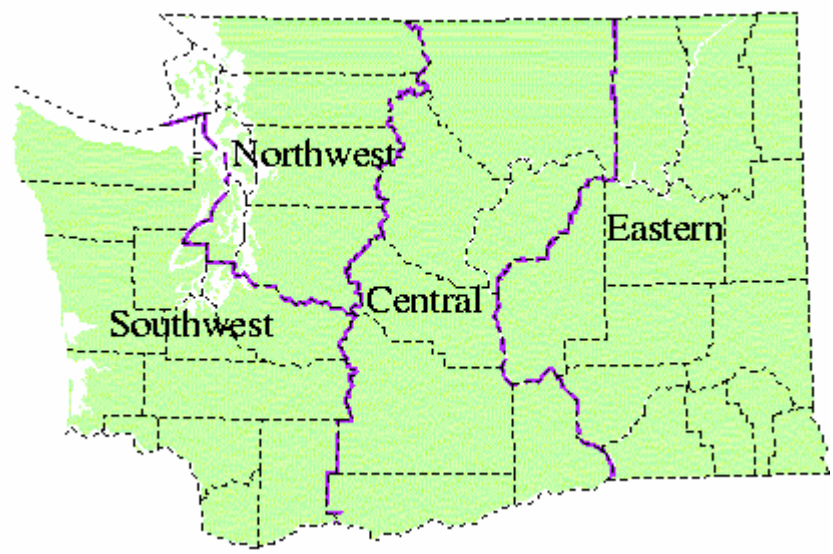
- Screen samples to 2 mm if necessary.
- Report on dry weight basis.
- Report in units of mg/kg or ppm.
- Use either of these methods: ICP/MS or GFAA.
- Analyze with analytical reporting limits no greater than:
    - arsenic, 5 ppm
    - lead, 10 ppm.

FORM 1
SAMPLE INVENTORY SHEET

Date _____
Page _____ of _____

Owner: _____ Property Address: _____ Phone No.: _____ **Sample No.**	**Date**	**Time**	**Composite (Y/N)**	**Testing Parameters** **Arsenic**	**Lead**			**Observations/Comments**

Instructions to laboratory:
1) Sieve samples to 2 mm prior to analysis if requested
2) Report results on dry weight basis in ppm or mg/kg
3) Sample analytical reporting limits are 5 ppm arsenic; 10 ppm lead
4) Perform analysis by EPA Method 6020A (ICP/MS) or 7010 (GFAA)



Source: Washington State Department of Ecology website (http://www.ecy.wa.gov/org.html)

WASHINGTON STATE DEPARTMENT OF ECOLOGY CONTACT INFORMATION:

Headquarters:	360-407-6000
Northwest Region:	425-649-7000
Southwest Region:	360-407-6300
Central Region:	509-575-2490
Eastern Region:	509-329-3400